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ABSTRACT

A description of the physics 3204 course in Newfoundland and Labrador is provided. The description includes: (1) statement of purpose, including general objectives of science education; (2) a list of six course objectives; (3) course content for units on sound, light, optical instruments, electrostatics, current electricity, Michael Faraday and the field concepts, and on further applications of electromagnetism; (4) required course materials; (5) statement on the philosophy of instruction (including comments on demonstrations, discussions, structured and independent class work, guided and pure discovery laboratory activities, and homework and study); and (6) comments on formative and summative evaluation. (JN)

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Course Description

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Department Of Education

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PHYSICS 3204

COURSE DESCRIPTION

DIVISION OF INSTRUCTION

AUTHORIZED BY THE MINISTER
FEBRUARY, 1982

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FOREWORD

There has been a significant increase in the number and variety of courses offered in Newfoundland and Labrador high schools as a result of the reorganized program introduced last September. Course descriptions make an essential contribution to the implementation of the program by defining philosophy, objectives, and content of the courses developed for introduction during the three-year implementation period.

Developed co-operatively by the Division of Instruction, School Districts and teachers, through a network of working groups across the Province, these publications are designed to assist teachers in translating course objectives into challenging learning experiences.

I trust the course descriptions will be of value to you in planning activities which enrich learning experiences for high school students.

Lynn Verge
Minister of Education

February, 1982

ACKNOWLEDGMENTS

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INTRODUCTION

Physics is the study of certain fundamental interactions involving matter and energy. At the senior high school level, mechanics, light, sound, heat, electricity, magnetism, astrophysics, and modern physics are dealt with. Physics involves products and processes, but also involves people; it is a human endeavour. Physics is an essential part of the history and culture of mankind.

Physics is regarded as a basic science, providing much understanding of the natural and technological worlds. There are no sharp divisions between physics and the other sciences; in fact, many of the concepts and constructs of physics are essential to studies and research in chemistry, and, increasingly, in the biological and earth sciences. Correspondingly, information from mathematics and the other sciences is utilized in many areas of physics.

Physics also provides scientific foundations for much of the transportation, communication, science research, home, and industrial technologies of the modern world. It is not surprising that a large percentage of careers and career-preparation programs require a basic understanding of physics.

STATEMENT OF PURPOSE

The senior high school science program must have as two of its objectives the development of skills and the acquisition of content specific to science. Students must continue the development of scientific processes such as communication, controlling variables, and formulating models. They must continue to acquire information related to the products of science such as laws, hypotheses, and theories. However, science education does not restrict itself to such a limited area. Science curriculum at the senior high school level must aid in the achievement of objectives which are not content specific but focus on a much broader development of mental attitudes or skills described as Category B Objectives in the Handbook for Senior High Schools of Newfoundland and Labrador. Science education contributes to:

1. the development of Christian principles and the application of these principles to life
2. the provision of opportunities for students to develop attitudes which are conducive to intellectual maturation and critical thinking, including:
   (i) a belief that the world can be understood in rational terms
   (ii) a belief in cause and effect relationships
   (iii) a habit of holding ideas tentatively and changing opinion when new evidence comes to light
3. the development of fundamental skills of communication and mathematics, and those skills necessary to pursue further study in various disciplines
4. the promotion of science and technology as products of our heritage
5. the fostering of an appreciation for the work of others, including methods used by scientists and responsibilities of scientists to society.

COURSE OBJECTIVES

Physics should contribute to the general objectives of science education stated previously. However, there are objectives which relate specifically to high school physics. Some of the objectives which Physics 3204 contributes to the achievement of are as follows:

1. to expose students to the study of the major products of physics such as definitions, physical constants, models and theories
2. to expose students to the processes of physics, and assist in the development of associated mathematical and manipulative skills
3. to make students aware of the nature of physics and its relationship to mathematics, other sciences, technology, and society
4. to expose students to a study of the history of physics in order to help them understand and appreciate physics as a human endeavour
5. to provide a treatment of relevant technological applications, such as communication, computers, medicine, and building construction
6. to create an attitude of enthusiasm for, and a willingness to participate in, the study of physics.

COURSE CONTENT

UNIT I: SOUND

A. Hearing and Hearing Loss
B. Noise
C. Sound Pressure Level
D. The Human Ear
E. Reflection, Reverberation and Absorption
F. Beats
G. Standing Waves and Resonance
H. Doppler Effect and Sonic Booms

UNIT II: THE NATURE OF LIGHT

A. Introduction
B. The Speed of Light
C. Simple Properties of Light
D. A Model for Light(Wave or Particle?)
E. Refraction
F. Total Internal Reflection
G. Diffraction
H. Interference
I. Polarization
J. Dispersion
K. The Aether - Fact or Fiction?

UNIT III: OPTICAL INSTRUMENTS

A. The Plane Mirror
B. Convex and Concave Mirrors
C. Lenses
D. The Eye and the Camera
E. Microscopes and Telescopes

UNIT IV: ELECTROSTATICS

A. Static Electricity
B. Electric Charge, and Structure of Matter
C. Coulomb's Law
D. The Unit of Charge
E. The Basic Forces of Nature

UNIT V: CURRENT ELECTRICITY

A. The Simple Circuit and Ohm's Law
B. Electric Circuits
C. Power and The Cost of Household Electricity
D. Household Circuits, and Safety

UNIT VI: MICHAEL FARADAY AND THE FIELD CONCEPTS

A. Michael Faraday: A Biographical Sketch
B. Fields and Forces
C. Electric Current: Magnetic Field
D. Electromagnets
E. The Electric Motor
F. Definition of Ampere
G. Deflection of Charged Particles in Magnetic Fields
H. Electromagnetic Induction

UNIT VII: FURTHER APPLICATIONS OF ELECTROMAGNETISM

A. The Potentiometer
B. Two-Way Switches
C. The Electric Bell
D. The Relay
E. The Induction Coil
F. AC and DC Generators
G. The Transformer
H. DC Motors
I. Electric Meters
J. Electricity and Society

COURSE MATERIALS

Required

Paul, D., et al., Physics - A Human Endeavour. Toronto: Holt, Rinehart and Winston of Canada Limited, 1977.

Module 4: "The Nature of Light and Sound"

Module 5: "Electricity"

PHILOSOPHY OF INSTRUCTION

The aims and objectives outlined have many implications for teaching physics. While some stress must be placed on the factual, the teacher should be aware that it is not the purpose of high school physics to train physicists or even to train prospective university physics students. The development of the general process skills of science and the development of desirable science attitudes that begin at the elementary level and are nurtured at the junior high level must be continued and enhanced by the high school level physics course.

The philosophy and objectives of high school physics require that students be actively involved in the learning process. They must be encouraged to question hypotheses, theories, and laws. They must be presented with challenging problems and be taught to develop satisfying methods of solution. Some problems will involve mathematics, some will involve experimentation, and all will involve thought. Teachers must be careful not to set themselves up as experts, with "instant" answers to all questions. The teacher's role, while at times authoritative, must be that of a leader, and coordinator of the learning process.

As far as teaching strategies are concerned, the key word is flexibility. Teachers must adapt their methods to suit a number of constraints: the characteristics of their classes, the school and community environment, audio-visual and laboratory equipment available, and the restrictions of time placed upon them by the school and the syllabus. Teachers must always be aware that students are being introduced to concepts and constructs in areas in which they have little prior experience. Students must learn a new language, new skills, and new attitudes, and, therefore, they must have time and opportunity to practice. Teachers will need imagination, persistence, and patience.

A variety of the following teaching-learning strategies is encouraged, to achieve the objectives of Physics 3204:

Lectures

The teacher plays a dominant role. Active student participation is limited.

Demonstration

Equipment and materials are handled by the teacher or by a small number of students. Although the teacher dominates, students are involved in formulating conclusions and evolving inferences.

Discussion

Many topics in physics, especially those involving physics and society, lend themselves to group discussions. The teacher should not dominate discussions, although the role of leader may be assumed by the teacher.

Structured Class Work

An understanding of many concepts in physics is facilitated by doing exercises and problems, often involving mathematics and always involving thought. The teacher often assigns the exercises and problems, and then is free to move around the classroom, assisting students.

Independent Class Work

The students study and learn individually or in small groups. Although careful planning with students is required, this approach tends to be less rigid from a student viewpoint than the structured activities previously described. This strategy permits a certain amount of self-pacing, the pursuit of tangential materials along lines of individual student interest, and the use of mastery learning techniques. It also allows students to "discover" new concepts and ideas. The teacher is a coordinator and consultant.

Guided Discovery Laboratory Activities

A problem is posed and materials are provided or suggested. Although directions are initially kept to a minimum, the teacher is there to guide and assist students.

Pure Discovery Laboratory Activities

As before, the students are provided with a problem and with materials. However, they determine their own method for tackling the problem, and, by themselves, interpret data, draw conclusions and formulate hypotheses for further testing. In the extreme, students would be required to find their own problem and sleect their own materials.

Homework and Study

Though students may be expected to plan and organize much of their own home study, the teacher will find it necessary to assign homework on either a group or individual basis.

Whatever the teaching strategy selected, careful planning is paramount. Teachers are encouraged to range through these strategies, and not to feel bound or constrained by one exclusive approach.

The teacher should not be tied to the student text book. The use of other books and written material, and audio-visual aids, is encouraged. This will encourage students to expand their reading beyond the textbook and thereby broaden their scope of learning and deepen their understanding of physics.

Laboratory activities should be integrated as much as possible into course content. An ideal situation would involve a classroom-laboratory facility where students could move easily from expository to laboratory conditions. It is often through laboratory activity that abstract concepts are given the concrete base which is so necessary for comprehension by the students at their level of mental development.

EVALUATION

Evaluation, the determination of the extent to which students have achieved the objectives established for the program, is, and should be, a major concern of teachers. In evaluating the physics program, it must be realized that while the majority of objectives pertain to the cognitive domain, student attitudes and feelings (the affective domain) and student manipulative skills (the psychomotor domain) are also important.

The evaluation of student achievement can be both formative, in which the evaluation is ongoing and used for the purpose of improving instruction and student performance, and summative, which involves evaluation for the purpose of grading and certifying students.

In formative evaluation, the teacher should utilize various techniques, such as quizzes, progress tests, standardized tests, assigned homework, term projects, experiment and activity writeups, practical laboratory tests, self-evaluation by students, interviews, and observation (especially for evaluation of laboratory objectives). The information received from the various sources should be used to give feedback to students about their strengths and weaknesses, to motivate students,and to modify instruction and improve the classroom process.

Summative evaluation should not be merely a one-shot event at the end of the course. It can take place at the end of a learning episode: a unit of study or a school term. Its purpose is to judge the students' achievement in relation to some standard of excellence, or in relation to some body of knowledge and skills they have attempted to master.

While both formative and summative functions may sometimes be embodied in the same evaluation tool, the teacher should take care not to confuse the two functions.*

*For a more detailed discussion, see The Evaluation of Students in the Classroom, Department of Education, 1979. This publication is available from the Evaluation Consultant, Division of Instruction (Testing).